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No. 39

THE CADDISFLY GENUS *BERAEA* IN NORTH AMERICA
(TRICHOPTERA)

By

Glenn B. Wiggins

TORONTO
NOVEMBER 30, 1954

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CONTENTS

INTRODUCTION AND RECORDED HISTORY OF <i>BERAEA</i> IN NORTH AMERICA	1
<i>Beraea fontana</i> sp. nov.	2
Male	2
Female	4
Diagnosis and discussion	4
Larva of <i>Beraea fontana</i>	6
Pupa of <i>Beraea fontana</i>	9
Notes on habitat and life history of <i>Beraea fontana</i>	11
THE IDENTIFICATION OF THE LARVAE AND PUPAE OF <i>BERAEA</i> WITH NORTH AMERICAN TRICHOPTERA KEYS	11
SUMMARY	12
ACKNOWLEDGMENTS	12
LITERATURE CITED	13
PLATES	14

THE CADDISFLY GENUS *BERAEA* IN NORTH AMERICA (TRICHOPTERA)

By
GLENN B. WIGGINS

INTRODUCTION AND RECORDED HISTORY OF *BERAEA* IN NORTH AMERICA

THE CADDISFLY FAMILY Beraeidae is at present divided into ten genera with the majority of the known species in the palaearctic region but with representatives also in South Africa, Australia, New Zealand and North America. In North America this family is represented by only one genus, *Beraea* Stephens. Of all the genera, *Beraea* contains the largest number of described species—six from the palaearctic and two from the nearctic regions. An additional North American species is described in this paper.

The recorded history of *Beraea* in North America is not extensive. Say's (1823:160) *Phryganea viridiventris* was listed by Hagen (1861:296) under *Beraea*. Hagen had not examined specimens, but expressed his opinion that the species might be the same as his *B. maculata* which was itself transferred later to another genus, *Protoptila* Banks. Milne (1936:61) suggested that *viridiventris* might be a hydroptilid. Ross (1944:292) questioningly listed it under *Protoptila*, and he has informed the writer (*in litt.*) that this action was "... based upon the combination of species at present found in the Kankakee River [Illinois] which appears to be much like that once (but not now) found in the type locality of *viridiventris*." Since Say's original description contains several points at variance with any of the North American species of *Beraea* now known, and since some evidence indicates that his specimens belonged to *Protoptila*, it seems reasonable to assume that *viridiventris* is not referable to *Beraea*.

Walker's (1852:121) *Beraea* ? *obscura* was based on two specimens, neither of which was a beraeid. One, a male of *Chimarra*, was designated as the type of *C. obscura* Walker (Betten and Mosely 1940:19) and the other, a female, was described by Betten and Mosely (1940:8) as *Synagapetus walkeri*.

Hagen's (1861:296) *Beraea* ? *maculata* was designated the genotype of *Protoptila* by Banks (1904:215) who had examined Hagen's type.

Banks (1897:31) described *Beraea nigrutta* from females collected at Sea Cliff, New York, in June. Banks did not give the date of the collection in his description. Smith (1900:63) listed *B. nigrutta* from Clementon, New Jersey, and it is implied in another section of his catalogue (p. 721) that this identification was made by Nathan Banks. It is not known how many specimens were in this collection, but the present writer examined two specimens labelled *Beraea nigrutta* Banks and bearing the same data as those given in Smith's catalogue, but

neither was a beraeid. These specimens are in the collection of the Wagner Free Institute of Science, Philadelphia, and were collected by C. W. Johnson in August, 1895. Efforts to find additional specimens with this identification in other institutions where Johnson worked have not been successful. It seems likely, therefore, that Smith's record is the result of a misidentification.

Betten (1934:250) referred to fragments of specimens taken near Ithaca, New York, which he said agreed with Banks's types of *nigritta*. Betten's material, consisting of fragments of specimens collected some time between 1901 and 1904 at Slaterville, New York, is now in the collection of the Royal Ontario Museum of Zoology and Palaeontology and, beyond the fact that it does belong to *Beraea*, cannot be identified on the basis of present knowledge.

Ross (1944:208) described *Beraea gorteba* based on males from Georgia; however, since the original description appeared, additional material, including both sexes, has been obtained.

Apparently no further records have been published for the North American species of *Beraea*, and the larva, pupa and habitat have never been reported for any of the known forms on this continent. All references to the immature stages of beraeids in keys to North American caddisflies have been based on European material.

In June, 1952, the writer collected one female beraeid at the source waters of Wilmot Creek near Leskard, about nine miles north of Bowmanville, Ontario. The following year, in June, 1953, several days were spent collecting in the same area and eventually a colony of beraeid caddisfly adults was located. Larvae and pupae of the colony were discovered as well.

Adults from this colony show definite morphological differences from specimens of *B. gorteba* Ross, and there can be little doubt that they do not belong to that species. It is possible that these specimens belong to the species *B. nigritta* Banks but since no males of this species have ever been reported, and since females of *nigritta* show slight differences, mainly in the genitalia, from females of this new material, it seems best to consider the position of *nigritta* as unsettled for the present and to describe another species based on this new colony.

It is hoped that by summarizing the present knowledge of *Beraea* on this continent and by describing the habitat and immature stages of one North American species, this paper will assist other workers to find additional material which is so essential for a satisfactory solution of the relationships of the North American species.

Beraea fontana sp. nov.

Male

Length from anterior margin of head to apex of folded wing 4.5 mm. General structure typical for genus. Colour in dried specimens various

shades of brownish black; tarsi lighter brown, particularly so in certain lights.

Head and appendages. Dorsum of head produced antero-dorsally and bearing two small warts at the apex; basal joint of antenna without a tooth; posterior warts of the head simple and not modified into processes.

Thorax and appendages. Anterior convex portion of mesoscutum (fig. 28) with a pair of small indistinct depressions or dimples; mesoscutellum with a pair of large triangular warts extending for about half the length of the mesoscutellum; each wart with an elongate patch of long dark brown hairs.

Wings oval and rounded at the apex, hind wings more rounded than front wings; wing venation as in figs. 29 and 30. Front wing (fig. 29) with basal callosity triangular; callosity with a patch of long hairs. Proximal quarter of R_1 thickened, bearing stout thick hairs and separated from the basal callosity by a deep abrupt groove in the wing; another broad thickening bearing long hairs extending from the basal callosity to the posterior edge of the front wing. Costal margin of front wing opposite basal callosity partially reflexed dorsally producing a rolled edge and between this edge and the thickened portion of R_1 is a dorsal pouch containing a small patch of scale-hairs. Hind wing (fig. 30) with a horn-like dorsal fold near base; patch of scale-hairs near the apex of this fold which grades distally into an elongate scattered patch of black seed-like scales extending across the central part of the wing; proximal third of costal margin thickened and bearing a row of stout hairs; anal area with a thickening bearing long hairs.

Femora of all legs rather sparsely covered with hairs; remaining distal segments of all legs, including spurs, densely covered with short hairs.

Abdomen and appendages. Sternum of abdominal segment VII with a prominent, mesal, pointed tooth, directed posteriorly, and arising from a swollen base. Segment VIII with a transverse band of long black hairs along the posterior margin of both tergum and sternum and a small patch of shorter hairs on the pleural membrane at each side.

Genitalia (figs. 25, 26, 27) similar to those of *B. gorteba* (Ross 1944: fig. 713); tergum of segment IX produced mesally into a pair of triangular lobes; laterad of the base of each lobe is a pointed sclerotized rod with a variable lateral tooth; this tooth may be prominent or entirely absent and both conditions or their intermediate gradations frequently occur on the same specimen. Base of each sclerotized rod continuous mesally with a vertical plate which is joined to the dorso-lateral margin of each triangular lobe but separate from the lobe along the ventral margin. Laterad of the sclerotized rods is a pair of short ovate cerci bearing short hairs. Claspers similar in structure to those of

B. gorteba and each composed of (1) a thin plate produced ventrally into a curved mesal filament, (2) a stout, circular, claw-like hook with base produced mesally into a hairy lobe approaching the tip of the claw, and (3) a curved dorsal lobe bearing long hairs. Aedeagus short, its vasiform base with widely flared edges; apical portion consisting of five convoluted lobes—one broad median ventral lobe, two narrower lateral lobes and two dorsal lobes. Between the two dorsal lobes is a small sclerotized plate. A pair of slender, curved, sclerotized styles emerges from the centre of these lobes.

Female

Length from anterior margin of head to apex of folded wing 5 mm. General structure and colour as in male; antennae slightly shorter. Venation different from male, as is the general condition for the family; venation of front wing similar to that illustrated by Betten (1934: pl. 31, fig. 1). Dorsum of first abdominal segment with a pair of irregular hairy patches; these patches sometimes present on the male, but much smaller. Genitalia (fig. 23) similar in general structure to those of *B. nigritta* (Ross 1944: fig. 711).

The specific name given to this species is based on the Latin *fontanus* meaning "from a spring".

Holotype, male: Leskard, Ontario; June 23, 1953; G. B. Wiggins.

Allotype, female: same data as holotype except June 16.

Both the holotype and allotype are in the collection of the Royal Ontario Museum of Zoology and Palaeontology and are preserved in alcohol.

Paratypes: Leskard, Ontario; 1953. Specimens in alcohol: June 16, 2 ♀ ♀; June 18, 3 ♂ ♂, 4 ♀ ♀; June 19, 1 ♀; June 20, 1 ♂; June 23, 3 ♂ ♂.

Pinned specimens: June 19, 3 ♂ ♂, 2 ♀ ♀.

Paratypes are in the collections of the Royal Ontario Museum of Zoology and Palaeontology (all pinned specimens; 5 ♂ ♂, 5 ♀ ♀ in alcohol) and the Illinois Natural History Survey (2 ♂ ♂, 2 ♀ ♀ in alcohol).

Diagnosis and Discussion

The male of this species can be readily distinguished from the male of *B. gorteba* by the genitalia. The dorsal sclerotized rods of *fontana* are neither as strongly sinuate nor as long as in *gorteba*. The slender styles of the aedeagus are only slightly curved in *fontana* but strongly sinuate in *gorteba*. In *fontana* the stout circular claw-like hook of the clasper is broader and more strongly curved, and the hairy lobe at its base is larger than in *gorteba*. The hind wing of *fontana* has only a

scattered patch of black seed-like scales, while in *gorteba* the hind wing bears a long dense patch.

The female of *fontana* is also most easily distinguished from that of *gorteba* by the genitalia. Immediately dorsal to the rounded ventral flap of segment VIII and concealed by this flap in uncleared material is a pair of broad lobes, one on each side of the genital opening. Each of these lobes is bifurcate. In *fontana* the mesal section of each lobe is sharply pointed, and the bulbous portion of the genital chamber is uniformly inflated with no sharp longitudinal creases. In *gorteba* (fig. 24) the mesal section of each lobe is more rounded and the bulbous portion of the genital chamber has a distinct longitudinal crease. In *fontana* the 8-shaped sclerotized pouch in the ventral wall of the genital chamber is narrow and the two loops are approximately equal in size. There is no circular pit in the floor of the anterior or basal loop. A narrow opening joins this pouch with the main part of the genital chamber. In *gorteba* the 8-shaped sclerotized pouch is broad and the basal anterior loop is definitely larger than the pointed posterior loop. There is a distinct circular pit or depression in the basal loop. The pouch opens into the main part of the genital chamber by a broad aperture. The shape of the lobes terminating the body is also different for each species (cf. figs. 23 and 24). The tergum of the first abdominal segment of *fontana* has a pair of hairy patches which is absent from *gorteba*.

In both sexes of *fontana* the warts on the mesoscutellum are elongate, roughly triangular and occupy about half the length of the mesoscutellum. In *gorteba* (Ross 1944: fig. 83) these warts are shorter and more rounded. Specimens of *gorteba* examined are slightly longer, more slender and lighter brown in colour than *fontana*. Measured from the anterior margin of the head to the apex of the folded wing, the lengths of specimens of *gorteba* examined by the present writer are 5 mm. for males and 6 mm. for females.

Two females of *nigritta* from the type locality were examined and on the basis of these specimens the female of *nigritta* is more closely related to the female of *fontana* than to that of *gorteba*. As evidence of this relationship, the following features are common to both *nigritta* and *fontana* females: darker brown colour and slightly shorter, less slender general appearance (cf. *gorteba*); two dimples on the mesoscutum; two irregular, hairy patches on the dorsum of the first abdominal segment; bulbous portion of the genital chamber uniformly inflated with no sharp longitudinal creases; bifurcate lobe on each side of the genital opening with the mesal section sharply pointed. Elongate warts on the mesoscutellum, similar to those of *fontana*, are present on one female of *nigritta*, while shorter rounded warts, similar to those of *gorteba*, are present on the other. The general appearance of the female genitalia of *nigritta*, shown by Ross (1944: fig. 711), is similar

to that of *fontana*. However, females of *nigritta* examined can be separated from *fontana* females by features of the 8-shaped sclerotized pouch in the ventral wall of the genital chamber. In *fontana* the two loops of this pouch are approximately the same size. In *nigritta* (fig. 22) the basal or anterior loop is distinctly broader than the posterior loop. Slight variation is apparent in the shape of the aperture connecting the pouch to the main part of the genital chamber in both *fontana* and *nigritta*, but the difference in the outer configuration of the loops described above is constant in the material examined.

Dr. Cornelius Betten made available to the writer fragments of specimens of *Beraea* females collected on June 27, 1932, at Putnam, Connecticut, by A. B. Klots. These included a specimen of female genitalia which appears identical to those of the specimens of *nigritta* examined.

Since males have not yet been definitely associated with typical *nigritta* females, no further comparison can be made between *nigritta* and *fontana*. Until this additional material is available, a better understanding of the relationships of the North American species of *Beraea* is more likely to result from the recognition of *fontana* as a distinct species.

Betten (1934:250) stated that the ventral abdominal tooth referred to in Banks's original description of *nigritta* was on the eighth segment. This tooth is on the seventh segment in *nigritta* females and in both sexes of *gorteba* and *fontana* as well.

Larva of BERAEA FONTANA

Length 6 mm.; maximum width approximately 0.8 mm. Eruciform; head and thorax approximately equal in width; first abdominal segment greater in circumference than thorax; abdomen tapering slightly from first segment (fig. 1).

Head and appendages. Head (fig. 3) flat and circular in dorsal view; colour bright brownish orange except for an unpigmented V-shaped area on the ventral surface bordering the occipital foramen and extending anteriorly to the gular sclerite (unpigmented area indicated in fig. 6). A sharp carina extending along each side of the head from a deep incision in the antero-lateral margin posteriorly to a point a short distance behind each eye (carina indicated by broken lines in fig. 3). Four pairs of clear hairs situated anteriorly on the fronto-clypeus*; one clear hair in the shallow notch at each antero-lateral corner; two other pairs postero-mesad from the first, with two hairs on

*Snodgrass (1947) believes that since there is no separating groove between frons and clypeus in Trichoptera, the two are best considered as a single fronto-clypeus and the term is used in this paper in that sense. The same author gives evidence to show that the so-called epicranial suture of the immature insect is only a cleavage line where the cuticle splits at ecdysis and does not define any

each side of the median line; the fourth pair posterior to the others at approximately the widest part of the frontoclypeus with one hair near each lateral margin. A darkened crescentic thickening extending transversely across the anterior portion of the frontoclypeus with the two ends terminating in the shallow notches at the antero-lateral corners of the frontoclypeus. Three small rounded pits immediately posterior to this thickening; one on the mid-dorsal line, one at each side between and slightly behind the bases of two clear hairs. Two pairs of slender brown hairs on the frontoclypeus posterior to the clear hairs; the first pair in a similar position to the posterior pair of clear hairs but a short distance behind; the second pair near the pointed apex of the frontoclypeus. Dorsal surface of the head bearing a number of slender brown hairs symmetrically arranged (fig. 3); ventral surface with several pairs of very fine hairs.

Antennae erect and prominent, situated near bases of mandibles on the sharp carina previously described and immediately behind a notch in the antero-lateral margin of the head; each antenna (fig. 4) mounted on a low projection and consisting of a short cylindrical stem terminated by a slender bristle and a clear inflated conical lobe. Eyes black and each surrounded by a clear area.

Labrum (fig. 2) brownish orange; transversely quadrangular with rounded margins; shallow mesal emargination on anterior border. Six pairs of clear bristles on the dorsal surface; three pairs on the antero-lateral border, mesal pair short and spur-like; two pairs in a transverse line across the central part of the labrum; one pair between these two series. Three small circular pits on the dorsal surface, one on the mid-dorsal line between the two mesal, clear bristles of the transverse series; the other two each antero-laterad from first. Area surrounding anterior emargination concave dorsally with the surface finely ridged, giving cobble-stone appearance; ridges more widely separated toward lateral and posterior margins, disappearing along postero-lateral border. Ventral surface of labrum with two patches of hairs, one on each side of the mid-ventral line, with some longer hairs in each patch projecting beyond the antero-lateral margin to appear in dorsal view; anterior mesal emargination with a dense row of minute hairs projecting beyond the anterior margin.

Mandibles (fig. 5) dark brown with tooth arrangement different on each side; left mandible slightly larger than right; each mandible bearing two brown hairs laterally and a brush of brown hairs mesally; brush on right mandible longer than brush on left.

fixed part of the cranium. According to this interpretation the frontoclypeus would have no definite boundaries and would be referred to as the frontoclypeal area, while the triangular portion bounded by the cleavage lines and by the anterior margin of the cranium would be called the frontoclypeal apotome. The term frontoclypeus, however, is retained in the present paper in its usual sense in the interest of uniformity in Trichoptera larval descriptions.

Maxillae and labium (fig. 6) with clear hairs and brownish orange sclerotized areas; maxillary palpi four-segmented and terminated by what appears to be a small divided lobe. Base of maxillary lobe with a patch of clear peg-like spines projecting beyond mesal border. Labial palpi two-segmented. Gular sclerite (fig. 6) narrow and transverse with antero-lateral corners sharply pointed.

Thorax and appendages. Pronotum (figs. 7, 8) collar-like and heavily sclerotized; colour bright brownish orange like the head except for an unpigmented crescentic area along the posterior margin. Each antero-lateral angle of pronotum produced anteriorly as a rounded lobe, and originating in each lobe is a prominent curved ridge extending transversely across the pronotum. Pronotum with small teeth projecting from the anterior edge and from the rounded lobes; fine brown hairs thickly scattered over the dorsal surface anterior to the transverse ridge; hairs posterior to transverse ridge longer and coarser and restricted to a small patch along each lateral border. Mesonotum (fig. 1) unpigmented and lightly sclerotized; uniformly covered with fine brown hairs. Metanotum (fig. 1) unpigmented; anterior half very lightly sclerotized and bearing a uniform covering of fine brown hairs. Thoracic sternites without hairs; posternal horn absent.

Front legs brownish orange, middle and hind legs lighter. Front legs (figs. 9A, 9B) short, strongly developed with broad circular femora and stout tarsal claws. Middle legs (figs. 10A, 10B) longer, more slender. Hind legs (fig. 11) longest, most slender, with extremely elongate tarsal claws; hind tarsal claws slightly shorter than hind tarsi, approximately three-fifths as long as hind tibiae. All legs with numerous slender brown hairs, particularly along edges of segments. Front and middle legs with stout spines; mesal surface of each femur of middle and hind legs with a longitudinal, scattered row of short, clear spines, these spines variable in number and arrangement (fig. 10B); middle femur with a stout dark hair on the mesal surface near distal end (fig. 10B). Posterior angles of middle coxae swollen, each bearing a dense patch of slender brown hairs.

Abdomen and appendages. Abdomen conical, tapering slightly caudad (fig. 1). Colour yellowish white in living insect but creamy white in specimens preserved in alcohol. Intersegmental grooves shallow; constriction between segments VIII and IX deeper than others, particularly in dorsal or ventral view. First segment with a low median hump and a broad lateral hump on each side (these three humps not obvious in specimens killed and preserved while remaining in their cases because abdomen assumes circular contour of interior of case; in living specimens or in specimens removed from cases before being killed, the humps are more clearly outlined). Two pairs of filiform gills on each of segments II and III. Series of minute bristles (figs. 1, 13) along mid-lateral line from segments II to VIII inclusive;

bristles scattered on segments II and VIII but linearly arranged on the intervening segments. Dorsum of segment IX with a transverse line of slender brown hairs along the posterior margin (fig. 15).

Tenth segment and appendages (figs. 12, 14, 15) with sclerotized areas varying shades of brown; two long stout bristles terminating the tenth segment dorsally, and dorsad from these a pair of small hooks each bearing a stout bristle at its base; stout hook at the end of each anal appendage with a slender hook immediately above it; a thick brush of brown hairs projecting mesally from the bulbous part of each appendage.

Five spherical lobes, presumably anal gills, inside the anal opening; these lobes apparent in living larvae where they are extruded periodically.

Case. Case (fig. 16) constructed of sand grains; conical, curved, and approximately 6 mm. long for fully developed larvae; narrowed posterior end closed by a convex silken membrane with a central oval opening (fig. 17).

Pupa of BERAEA FONTANA

Length 5 mm.

Head and appendages. Labrum semi-circular in outline, flat and lying in same plane as the frontoclypeal region of the head; three brown hairs in each postero-lateral corner; patch of brown hairs along rounded anterior margin.

Four brown hairs immediately above labrum, with two hairs, one above the other, on each side of the mid-dorsal line; a small brown hair near the base of each mandible; a pair of short brown hairs between each compound eye and the adjacent antenna; a pair of similar brown hairs on the first segment of each antenna; a pair of longer brown hairs between bases of antennae. Antennae slightly curved conforming with general body outline and extending approximately to seventh abdominal segment. Mandibles (fig. 19) sharply pointed; each mandible with a mesal row of small saw-like teeth and a pair of brown hairs on the lateral edge near base. All hairs on head and appendages slender and simple, none being hooked apically.

Thorax and appendages. Mesonotum with three pairs of slender brown hairs symmetrically arranged in two longitudinal rows of three hairs on each side of the median line. Metanotum with two pairs of brown hairs symmetrically arranged on each side of the median line as on the mesonotum. Hairs on both mesonotum and metanotum variable in number with additional hairs sometimes present.

Legs slightly compressed, each leg without hairs or with one or two fine hairs. Wings extending to fifth abdominal segment; front wings slightly longer than hind wings; pupal integument covering each wing

produced at apex into a stout point curving slightly dorsad, pointed apex longer on front wings than on hind wings.

Abdomen and appendages. Each tergum and sternum of segments II to VIII inclusive with a pair of sclerotized, brownish orange, longitudinal bars, one on each side of the mid-dorsal and mid-ventral lines (fig. 18); the two bars on the first tergum shortest and least sclerotized. Dorsum of each segment with minute file-like teeth, most abundant between the sclerotized bars; a few teeth on the pleural membrane; teeth restricted to posterior half of first segment, and to anterior half of seventh segment, but more uniformly distributed on intervening segments. Beginning with first segment and moving posteriorly, teeth on succeeding segments gradually diminishing in size to the seventh where smallest teeth occur; teeth on segments VIII and IX and on the envelope covering the genitalia much coarser than the teeth on preceding segments; small circular area laterad of sclerotized bar on each side of segment VIII free of teeth. Very small, clear hairs on the tergum and sternum of each segment with arrangement fairly constant on segments I to VII inclusive; eighth tergum with a row of brown hairs along posterior margin and with a small, clear hair on each side laterad of the sclerotized bar; ninth tergum with a patch of brown hairs on each side and intergrading with these on the lateral periphery of each patch are several smaller, clear hairs. Each sternum of segments II to IX inclusive also with small, clear hairs arranged in a slightly curved transverse line across the middle of each sternum, with a single hair in each antero-lateral corner. Similar small, clear hairs on the pleural membrane.

Each tergum of segments III to VI inclusive with a pair of posteriorly directed, sclerotized hooks on the anterior margin; each hook arising from a sclerotized oval plate, usually with one large hook per plate, although this is variable, the large hook sometimes armed with small teeth, sometimes bifurcate. Tergum of segment V with a pair of stout sclerites on posterior margin; each sclerite usually with a pair of hooks directed anteriorly, although smaller side hooks sometimes present on the two large hooks.

No lateral fringe of hairs on abdomen; gills absent. Pupal integument covering genitalia produced posteriorly into a pair of short lobes or anal processes, each terminated by a sclerotized, bifurcate process curving dorsally (fig. 20); dark brown hairs on these terminal processes and surrounding integument. Ventral surface of ninth segment of male with median rounded lobe bearing a postero-median incision; this lobe absent from female.

Case. Apparently there is no alteration of the larval case immediately preceding pupation; anterior opening of case sealed by a silken membrane (fig. 21) with a crescentic slit at one side; membrane attached directly to anterior lip of case.

Notes on Habitat and Life History of BERAEA FONTANA

The habitat of the colony from which the specimens of *B. fontana* described in this paper were taken is a boggy area surrounding a number of small springs which issue from the side of a low ridge. The side of the ridge is covered with eastern white cedar trees but there are several open boggy areas scattered among the trees. In these surroundings larvae and pupae are found in the open boggy areas at the edges of small spring runs. Here they live in wet soil amid tangles of mosses and plant roots. They can be exposed by sifting samples of wet mud and plants in running water. Several attempts were made to find larvae in the spring runs themselves, but only a few empty cases were found.

Prior to pupation the larva fastens a loose convex plug of plant fragments over the anterior opening of the case and then, under this plug, spins the silken membrane which closes the anterior opening. The anterior end of the pupal case is fastened to plant material by silken strands. A few larvae were kept alive in water in a small glass dish for several weeks and these left a silken strand behind them as they crawled about over the plants. Collections of larvae showed two general size groupings, suggesting that two years are required for completion of the life cycle.

The adults were very active during the day, running rapidly over the low plants growing in the boggy area and making short rapid flights from one plant to another. Cedar trees growing at the edges of the boggy area also sheltered the adults. Adults were collected in 1954 from June 7 to July 16. The adults were very difficult to find on both of these dates but were much more abundant at times during the interval, indicating that the length of the period of adult emergence would be approximately six weeks. Oviposition was not observed, but some of the females released a spherical, gelatinous egg mass when placed in alcohol.

THE IDENTIFICATION OF THE LARVAE AND PUPAE OF *BERAEA* WITH
NORTH AMERICAN TRICHOPTERA KEYS

Ross's (1944:22) keys to the families of North American larval and pupal Trichoptera are the most readily available to North American students, but in the absence of knowledge of immature stages of the Beraeidae from this continent, the characters in these family keys were based on European material from Ulmer (1909). The present description of these stages now makes possible some improvement in the keys.

In couplet 14 of Ross's larval key to the families, the Brachycentridae are separated on the basis of a deep furrow running transversely across the pronotum. This feature is shared by the larva of *Beraea fontana* and by all other holarctic species of *Beraea* for which the larvae are

known. Since *Beraea* is the only genus of the family known in North America, this pronotal furrow would be expected in all the North American larvae of the Beraeidae. The two families can be readily distinguished, however, by the long tarsal claws of the hind legs, as stated by Ross in couplet 15. A reversal of couplets 14 and 15 would eliminate any confusion. The hind tarsal claws of *B. fontana* described in the present paper are very long and slender but they are not as long as the tibiae, as suggested for beraeids in this key.

In the same paper, the pupal key to the families separates the North American Beraeidae (i.e. *Beraea*) in couplet 6 by the characteristic shape of the anal processes, but the description and illustration (Ross 1944: fig. 45B) of these processes as curving ventrad in lateral view does not hold for the pupa of *Beraea fontana* described in the present paper. In this case the processes curve dorsad (fig. 20) and the same undoubtedly holds true for all the North American species of *Beraea*. Characters in the key were based on illustrations of a European species, *B. maurus* (Curtis), from Ulmer (1909:305) but Ross's figure 45B was inverted, an understandable error since Ulmer's figure was placed obliquely. Apparently there is no evidence that the anal processes of any *Beraea* pupa do not curve dorsad.

The above remarks also apply to other keys for North American larval and pupal Trichoptera, such as those of Pennak (1953), which are based on Ross's (1944) keys.

SUMMARY

The caddisfly family Beraeidae is represented in North America by one genus *Beraea* which is known only from the eastern part of the continent. Several species have been described in this genus but at the present time only two, *B. gortebe* Ross from Georgia and a new species described in this paper from Ontario, *B. fontana*, are recognizable from both sexes. A third species, *B. nigritta* Banks, from New York, is known only from females and its status must be considered as unsettled until additional material is available. The larva, pupa and habitat of *B. fontana* are described, marking the first account of this information for a beraeid caddisfly in North America. Improvements are suggested for identifying the larvae and pupae of *Beraea* with the keys now in current use in North America.

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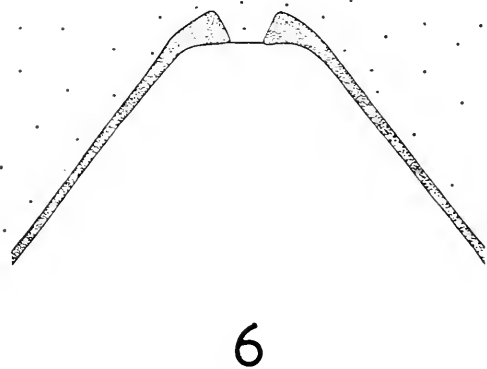
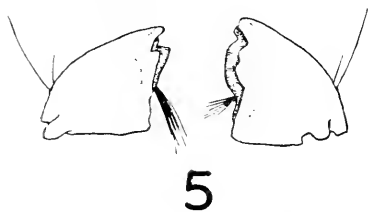
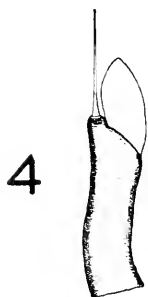
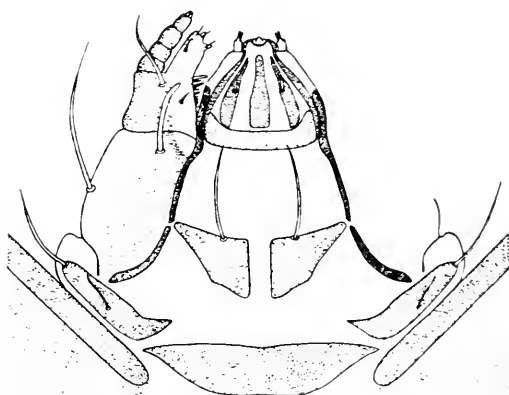
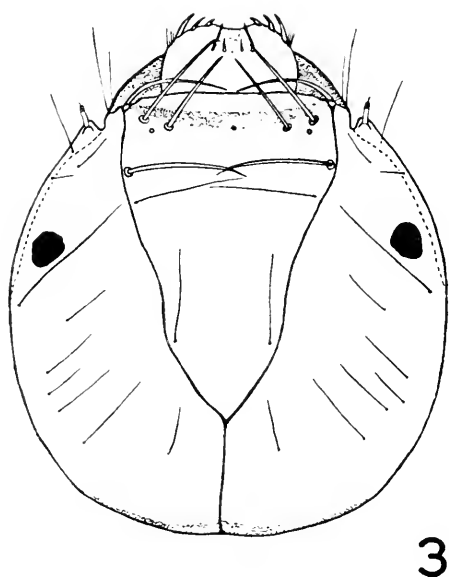
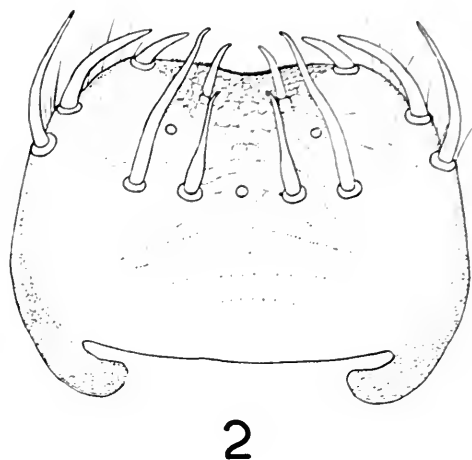
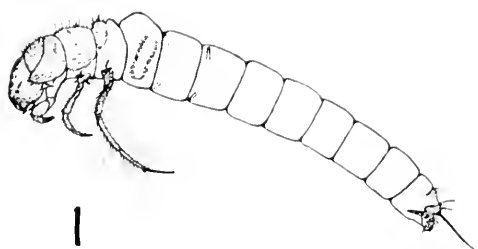
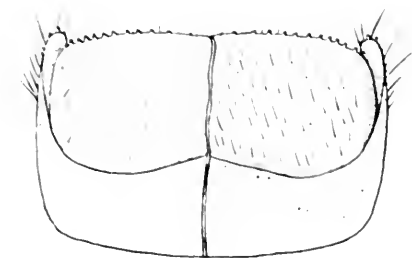
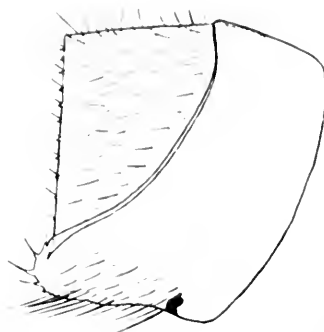


PLATE I. *Beraea fontana*, larva

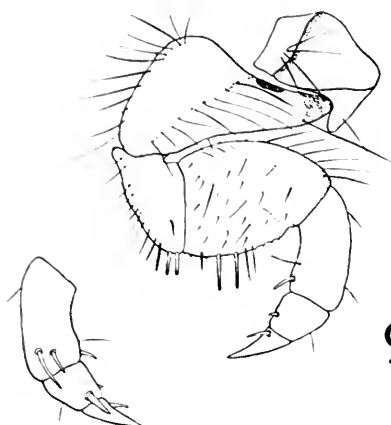
FIG. 1, larva; FIG. 2, labrum, dorsal view; FIG. 3, head, dorsal view; FIG. 4, antenna; FIG. 5, mandibles, ventral view; FIG. 6, maxilla, labium and portion of cranium, ventral view.



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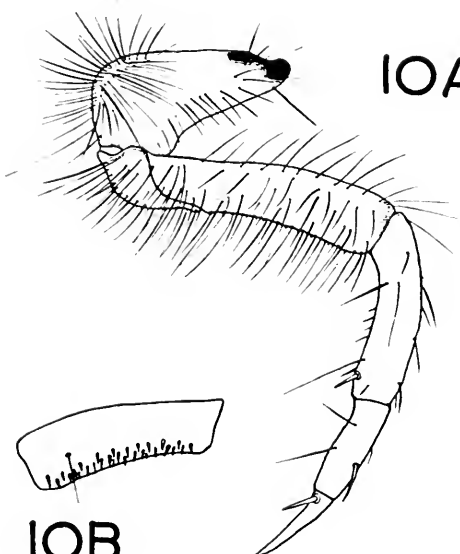


9A

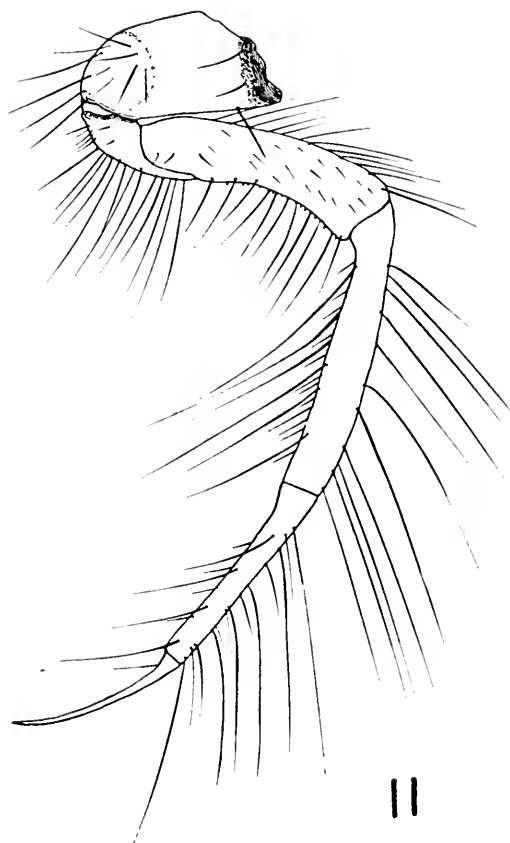
9B



10A



10B



11

PLATE II. *Beraea fontana*, larva

FIG. 7, Prothorax, dorsal view; FIG. 8, prothorax, lateral view; FIG. 9A, first leg, lateral view; FIG. 9B, distal portion of first leg, mesal view; FIG. 10A, middle leg, lateral view; FIG. 10B, middle femur, mesal view (hairs omitted); FIG. 11, hind leg, lateral view.

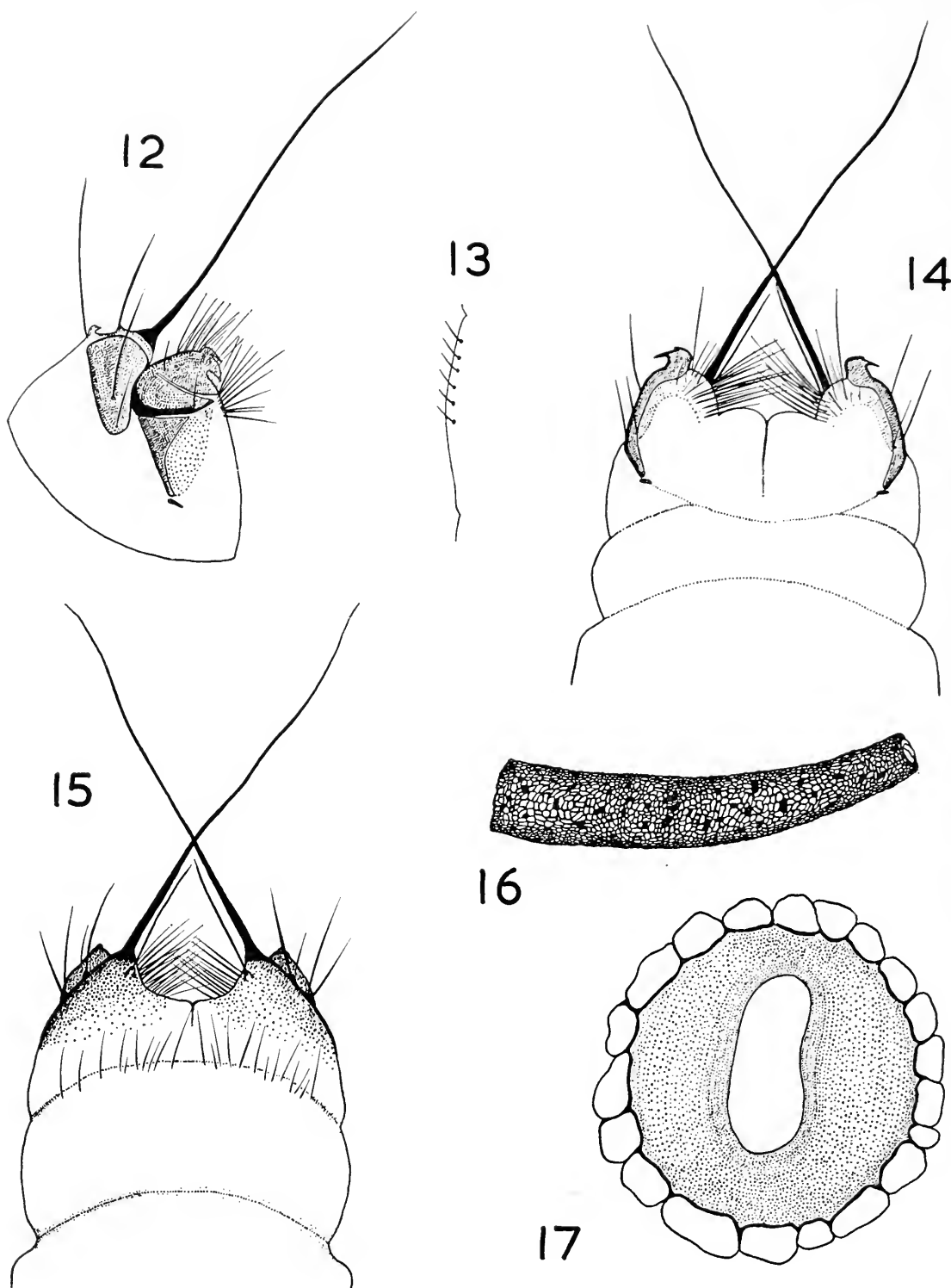


PLATE III. *Beraea fontana*, larva

FIG. 12, end of abdomen, lateral view; FIG. 13, edge of abdominal segment VII, dorsal view; FIG. 14, end of abdomen, ventral view; FIG. 15, end of abdomen, dorsal view; FIG. 16, case; FIG. 17, posterior end of case.

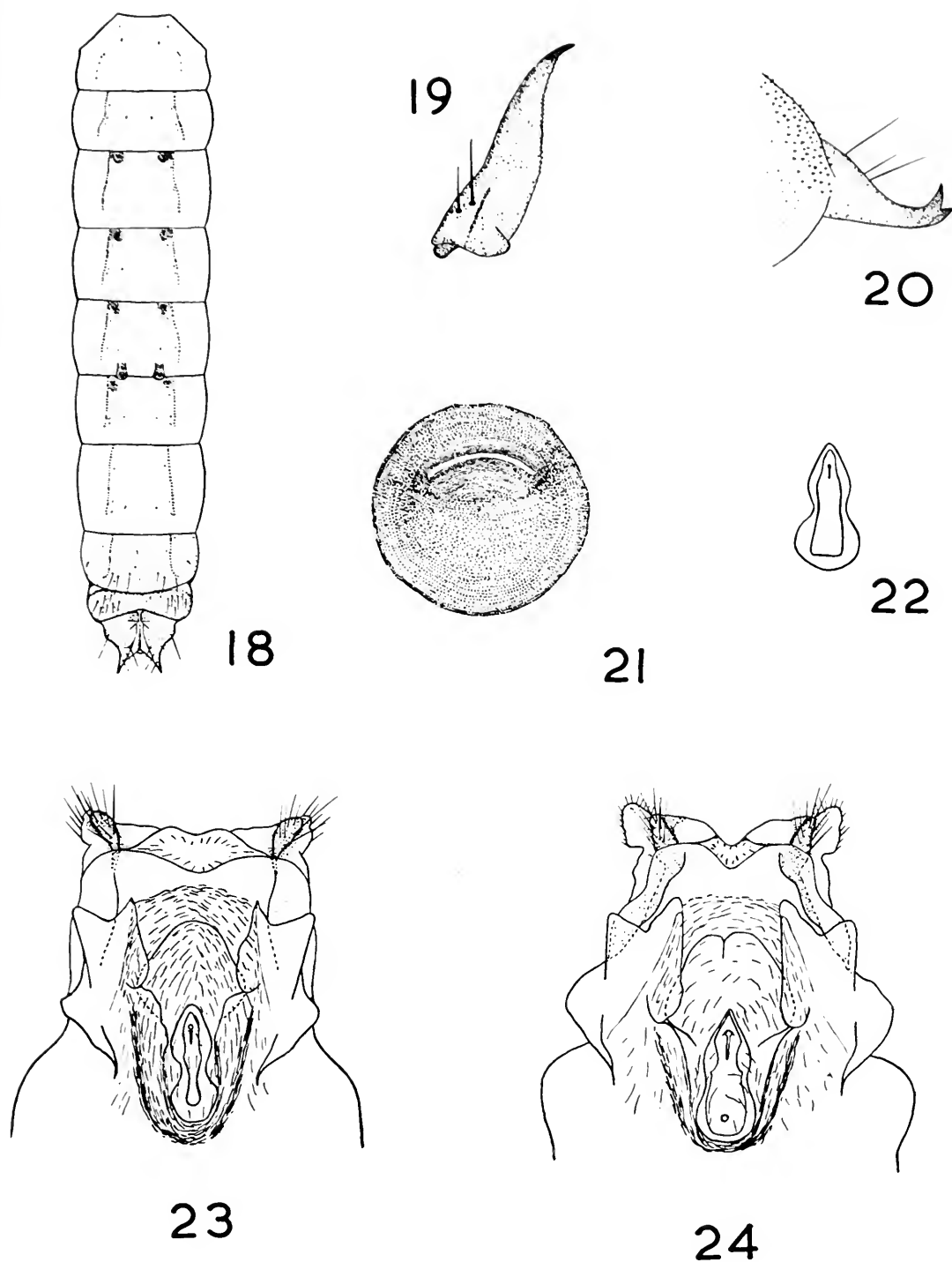


PLATE IV

FIG. 18, *Beraea fontana*, pupal abdomen, dorsal view; FIG. 19, *B. fontana*, pupal mandible, dorsal view; FIG. 20, *B. fontana*, pupal anal process, lateral view; FIG. 21, *B. fontana*, silken membrane covering anterior opening of pupal case; FIG. 22, *B. nigritta*, female, 8-shaped pouch in floor of genital chamber, ventral view; FIG. 23, *B. fontana*, female genitalia, ventral view (ventral lip of segment VIII removed); FIG. 24, *B. gorteba*, female genitalia, ventral view (ventral lip of segment VIII removed).

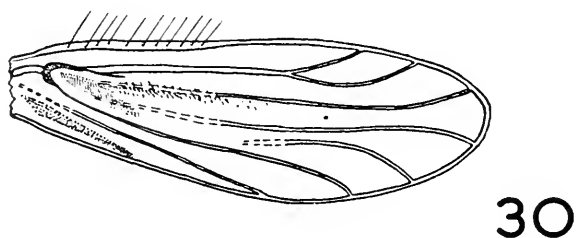
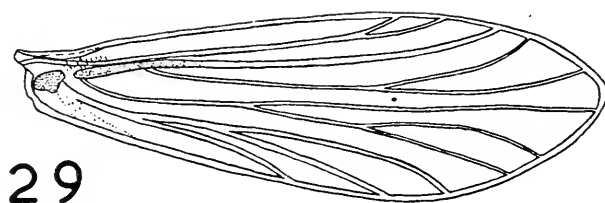
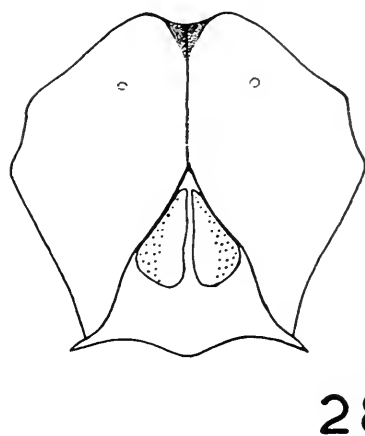
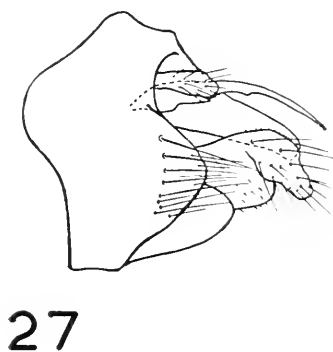
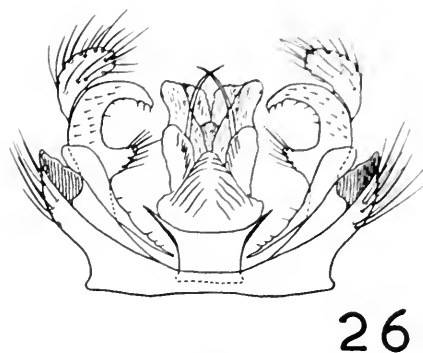
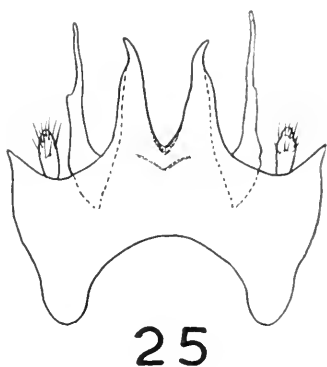


PLATE V. *Beraea fontana*, male

FIG. 25, genitalia, dorsal view (ventral structures omitted); FIG. 26, genitalia, ventral view (dorsal structures omitted); FIG. 27, genitalia, lateral view; FIG. 28, mesonotum, dorsal view; FIG. 29, front wing, dorsal view; FIG. 30, hind wing, dorsal view.

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